3 Sheets—Sheet 1.

P. W. GATES.

Ore-Crusher.

No. 196,082. **Patented Oct. 16, 1877.**

Fig. 1

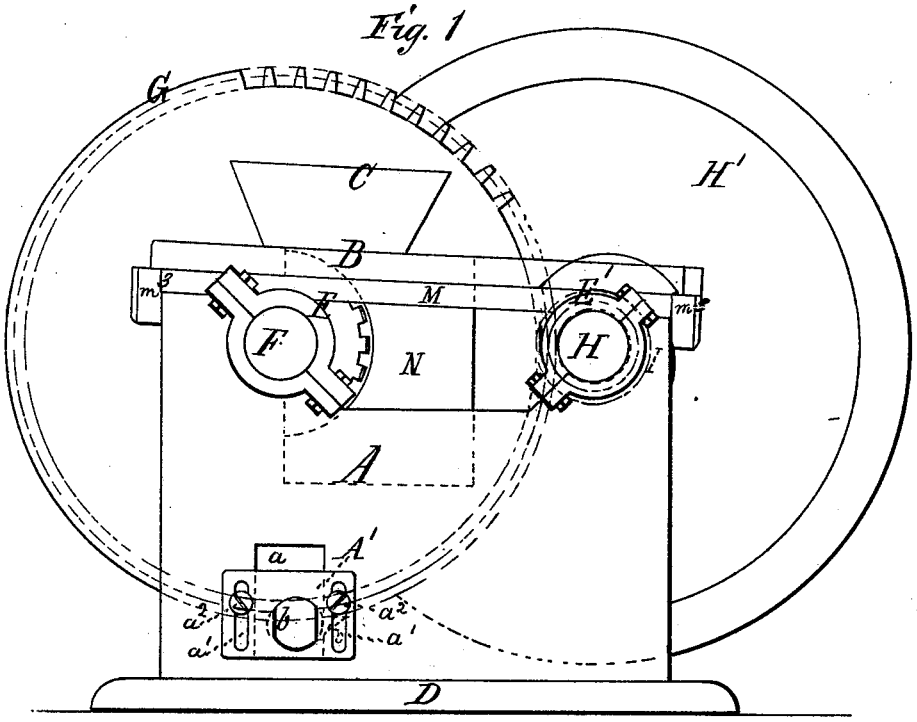
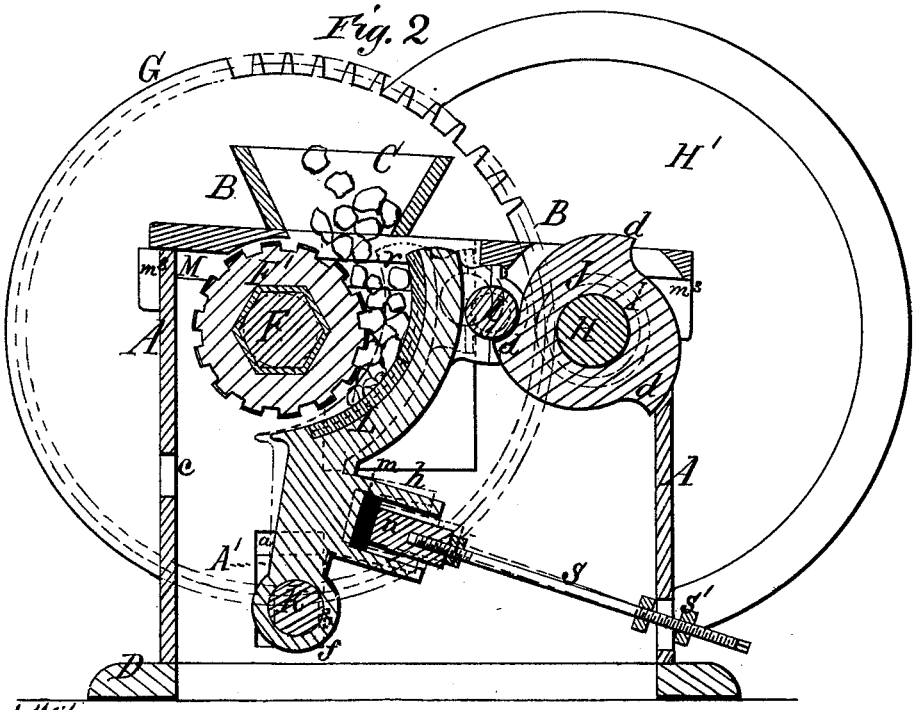


Fig. 2



Witnesses.
James Martin Jr.
J. P. Theodore Lang

Inventor.
Philetus W. Gates
by Mason Fenwick & Lawrence Attys.

3 Sheets—Sheet 2.

P. W. GATES.

Ore-Crusher.

No. 196,082. Patented Oct. 16, 1877.

Fig. 3

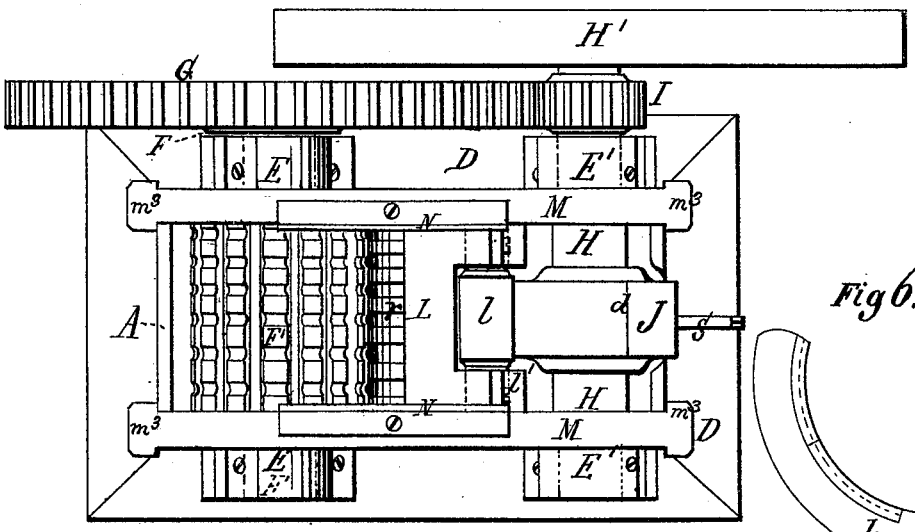


Fig 6.

Fig. 4.

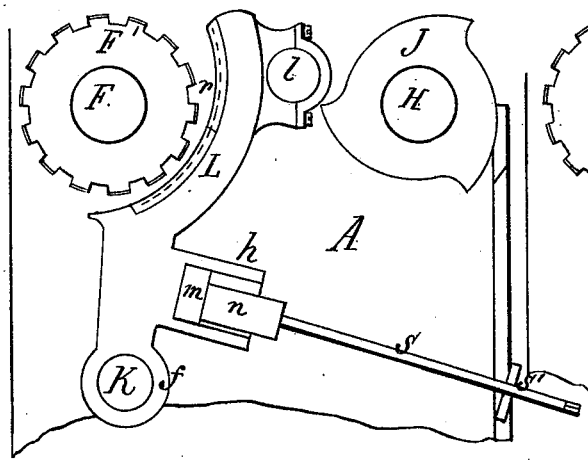
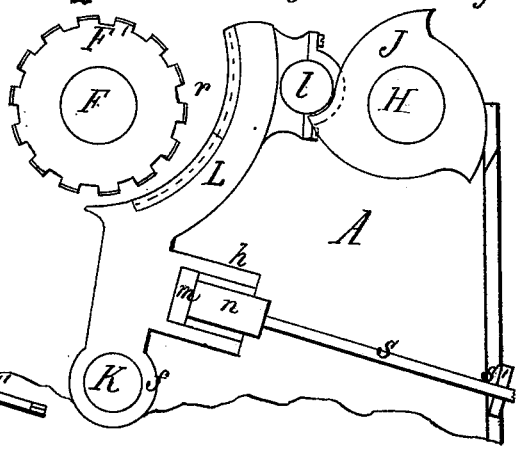


Fig. 5



Witnesses.
James Martin Jr.
J. P. Theodore Lang

Inventor.
Philetus W Gates
by
Mason Fenwick & Lawrence
Attys

3 Sheets—Sheet 3.

P. W. GATES.
Ore-Crusher.

No. 196,082. Patented Oct. 16, 1877.

Fig 7.

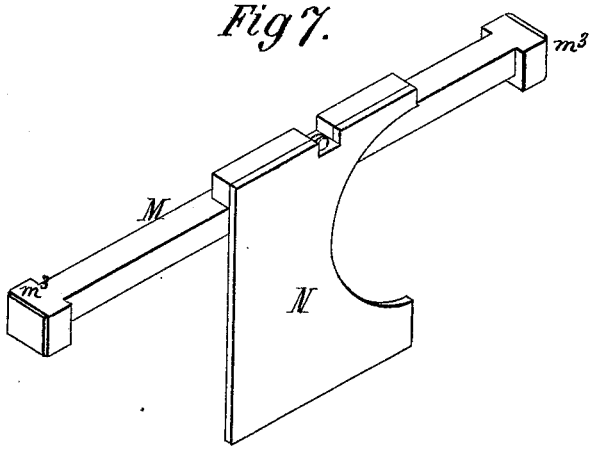


Fig 8.

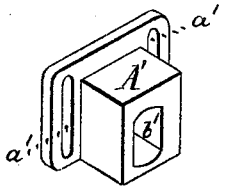


Fig 9.

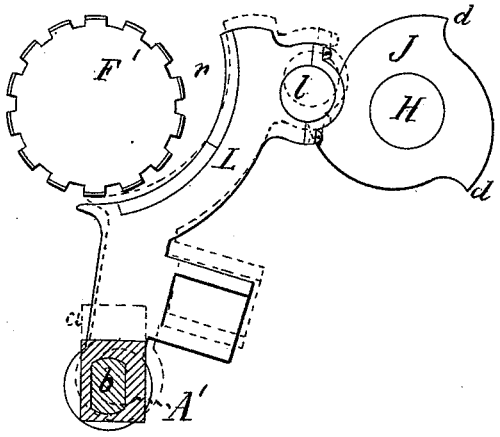
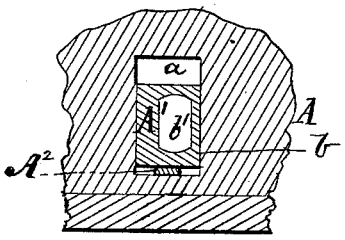


Fig 10.



Witnesses:
James Martin Jr.
J. P. Theodore Lang.

Inventor:
Philetus W. Gates
by
Mason, Fenwick & Lawrence

UNITED STATES PATENT OFFICE.

PHILETUS W. GATES, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN ORE-CRUSHERS.

Specification forming part of Letters Patent No. **196,082**, dated October 16, 1877; application filed July 3, 1877.

To all whom it may concern:

Be it known that I, PHILETUS W. GATES, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Machines for Breaking Stone; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a side elevation of my improved stone-breaker. Fig. 2 is a vertical longitudinal section of the same. Fig. 3 is a plan or top view of the machine, with the hopper and cap removed. Fig. 4 is a diagram, showing the relative position of the parts when the machine is either still or running, and without stone between its breaking-surfaces. Fig. 5 is a similar diagram, showing the relative position of the parts when the machine is either still or running, and with stone between its breaking-surfaces. Fig. 6 is a modification of one part of my invention. Fig. 7 is a perspective view of one of the longitudinal tie-bars used to strengthen the frame at the top, with shield attached. Fig. 8 is a perspective view of one of the two reversible sliding bearings in which the fulcrum-bar of the swinging jaw is secured eccentrically. Fig. 9 is a diagram, showing the different relative positions of the swinging jaw obtained by means of the reversible sliding bearings. Fig. 10 is a sectional detail view of the sliding bearing, showing the mode of raising it.

My present invention relates to an improvement on a stone-breaker for which Letters Patent, dated November 7, 1865, and numbered 50,813, were issued to Philetus W. Gates and David R. Fraser; and the nature of my invention consists in certain constructions, combinations, and arrangements of parts, whereby several very important results are secured, of which I will here name the following:

First, the movable crushing-jaw can be forced up to its work by a revolving tappet-wheel or cam on the shaft of the fly or balance wheel, instead of by a connecting-pitman attached to the movable jaw and to the driving-shaft, and thereby a greater number of motions of the jaw than the revolutions of the said wheel are effected; and while this is the case, clogging of the machine at its discharge-passage is prevented by having one of the crushing-surfaces to turn or revolve as the crushing progresses. Second, the movable jaw, when either still or moving, and without stone between its own and a fellow crushing-surface, is kept out of contact with the driving tappet-wheel or cam, and thus useless wear and destruction of the jaw and tappet-wheel or cam are avoided while the work of breaking stone is not being performed and the driving-power is still revolving the tappet-wheel or cam.

In the accompanying drawings, A represents a strong frame, closed in on all sides as far as practicable, and provided with a suitable removable cap, B, with a hopper, C, attached to it. This frame rests upon a strong open bed-plate, D, and is provided with journal-boxes E E, for the support of the shaft F of a metal crushing-cylinder, F′, and a spur-gear wheel, G, and with similar boxes E′ E′ for the support of the driving-shaft H, on which is a balance-wheel, H′, toothed pinion, I, and a tappet-wheel or cam, J, as shown. This frame has an elongated slot, *a*, in each of its sides for bearing-blocks, which carry the flattened ends *b* of the pivot K of a metal crushing-jaw, L, to fit and slide up and down in; and in the discharging end of the frame an aperture, *c*, is formed for a chute to fit in for conducting away the broken stone. Any other proper construction of frame may be employed without departing from my invention.

In the drawings the metal crushing-cylinder F′, which revolves, is shown as working in combination with a metal crushing-jaw which vibrates, and is concave on its crushing or working face; and a tappet-wheel or cam, J, with three projections, *d*, is represented as the means for forcing the jaw L toward the cylinder and up to its work of breaking stone. The jaw L, as shown by the drawings, is so constructed and arranged with respect to the cylinder F′ that a space, *r*, which flares or gradually increases in size from the delivery-point to the point of receiving the stone to be crushed is formed between it and the cylinder.

If it is desired to have the crushing-surface represented by F′ stationary, its form and that of the jaw L may be changed without

departing from that part of my invention which relates to the means for throwing the jaw L out of action when stone is not between the crushing-surfaces; and it is not important, with respect to the action of the spring *m* and rod S upon the jaw, whether the motion of the crushing-cylinder be produced by spur-gearing, screw-gearing, or a ratchet movement; but when it is desired to have the surface represented by F′ to revolve continuously and slowly this surface should be cylindrical, and I prefer to have its shaft geared with the tappet-wheel or cam-shaft by means of the spur-wheel G and pinion I, as represented.

The working-faces of the crushing devices, as represented by F′ and L, may be constructed, respectively, in any of the known practical ways; but I prefer to form annular grooves and ribs on the cylinder F′, and to intersect these grooves and ribs by deeper longitudinal grooves, and thus have knobby projections or steep teeth formed on the crushing device represented by F′; and on the concave L, I prefer to make corrugations, or grooves and ribs, which run up and down, but not across the crushing-face. For some kinds of materials the concave surface of the jaw L may be smooth on its surface, and the cylinder on its surface may be grooved and ribbed longitudinally, and not have annular grooves and ribs.

The movable jaw L is fitted loosely by its lower end *f* to the pivot K, and swings back and forth thereon, while the pivot is prevented from turning by having its flattened ends *b* fitted in flat-sided bearing-blocks A^1, which slide up and down in elongated slots *a* of the frame A. The said sliding blocks A′ have side flanges with vertical slots a^1 therein, and are, by means of set-screws a^2, passed through the said slots into the frame fastened to the frame A, so that they, with the shaft K, may move up and down without separating from the frame. The bearing-apertures *b′*, into which the flattened ends *b* are inserted, have a laterally and vertically eccentric position in the blocks A^1, so that when the blocks are reversed in the slots *a*, the position of the jaw L is so changed as to effect the desired change in the size of the crushing-space *r*, and thus adapt the machine for breaking stone of different sizes without changing the proper operative relation of the swinging jaw with the other parts of the machine.

The size of the delivery-aperture at the lower end of the space *r*, between the crushing-surfaces represented by F′ and L, may be decreased, without reversing the blocks A^1, by inserting a long flat bar, A^2, through the slot *a* under the said blocks of the pivot K, from side to side of the frame, as shown in Fig. 10; or the said space may be increased by withdrawing this bar A^2 and inserting a thinner one. By this means the crushing-surfaces can be regulated for breaking stone to sizes varying from one-fourth to two inches, more or less, according to the various thicknesses of the bars employed for adjusting the jaw L.

At the upper end of the jaw L a metal friction-roller, *l*, is hung in journal-boxes *l′ l′*, for the projections *d* of the tappet-wheel or cam J to impinge upon, and thereby force the jaw up to its work. The friction-roller *l* may be of steel, and it serves to prevent wear of the jaw, and when it is worn down a new one may be supplied in its place. On the jaw L, between its pivot K and the terminus of its concaved portion, a socket, *h*, is formed, and in this socket a spring of rubber, or a spiral or other suitable metal spring, *m*, is fitted, as shown, and against this spring a stationary plug, *n*, which, on the end of a strong rod or bar, *s*, bears with great force.

The rod *s* is fitted by a screw-thread on it and two nuts, *s′*, screwed firmly against both sides of the frame A, and it can be set to bear heavier or lighter upon the spring *m*, as occasion may require, by screwing or turning the nuts.

By means of the spring *m* and the bar *s* the jaw L is kept out of contact with and range of the cam J at all times when the space *r* between the crushing-surfaces, represented by F′ and L is not occupied with stone to be broken, and thus unnecessary noise and wear are prevented; but when said space is occupied in part or wholly with stone to be broken, the elasticity of the spring *m* permits the stone which is to be broken by the surfaces represented by F′ and L to force the jaw in contact with the tappet-wheel or cam, so that the tappet-wheel or cam projections *d* will forcibly press it up to its work of breaking the stone between the surfaces named.

The rod *s* may have its end passed loosely through the leg of the jaw, and a spiral or rubber spring be placed on the rod between the jaw and a nut, *w*, and another nut, *w′*, may be placed on the rod so as to bear against the frame A, as shown in Fig. 6.

In manufacturing parts of the stone-breaker herein described, it is preferable to make the cylinder F′ a cast shell of white or chilled iron, and place it on a six-sided shaft, and run Babbitt metal or other like metal in the space between the shaft and shell, so as to make the cylinder solid; and the movable jaw L may have its working-face of white or chilled metal, and constructed separate from the jaw proper, and set in a recess cast in the jaw, so that when the lower portion of this working-face is worn out, the working-face may be turned upside down and a new wearing portion of the face brought into use, or so that a new working-face may be substituted for a worn-out one. The tappet-wheel or cam may also be made of white or chilled metal.

In order to have the machine capable of bearing the great strain it is subjected to, as in crushing quartz or other very hard stone or ore, the frame is strengthened by means of removable tie-bars M, with a T-shaped head, m^3, or nuts at each end. The said tie-bars are suit-

ably inserted into the top part of the frame, and as near as practicable to the bearings of the fly-wheel shaft and crushing-roller, while the heads m^3 or nuts bear against the ends of the frame; and to these tie-bars side shields N, of suitable shape, are attached, whereby the stones are prevented from leaving the crushing cylinder and jaw sidewise, and filling the frame of the machine and clogging the operation.

A single screw-tapped plate, as at s', Fig. 4, for the rod s to be adjusted by, might be substituted for the two nuts s' shown in Fig. 2.

The operation of the machine is as follows: The machine being set in motion, stone is placed between the crushing-surfaces, and the movable jaw is moved from the position shown in Fig. 4 to the position shown in Fig. 5. The driving-shaft being in motion, the tappet-wheel or cam J is caused to strike the jaw L and move it up to its work three times during each revolution of the shaft H, and simultaneously with this motion of the jaw the pinion I moves the spur-wheel G, and causes the crushing-cylinder F′ to turn slowly, and thereby assist in the operation of feeding down the stone to be broken, and in breaking the stone. The motion of the cylinder also assists in discharging the broken stone from between the crushing-surfaces, so as to prevent clogging while operating rapidly.

When the machine is not fed with stone the spring m forces the jaw L away from the tappet-wheel or cam, and the tappet-wheel or cam, in its revolutions, does not strike the friction-roller l on the upper outside surface of the jaw.

In the machine constructed in accordance with Letters Patent granted to Gates and Fraser, herein referred to, a pitman-connection is used, and the fly-wheel shaft has the same motion as the movable jaw, and the cylinder driven by a single gear runs too fast and causes great wear, and if run with double gear it is objectionable, on account of the liability to break and soon wear out; but by employing the tappet-wheel or cam, which will give two, three, or more motions to the jaw for one of the fly-wheel, these difficulties are overcome; for with the large spur-wheel on the cylinder-shaft and a small pinion on the fly-wheel shaft—say, about five to one—the cylinder will make twenty revolutions to one hundred of the fly-wheel, while the jaw will make three hundred motions forward.

The proportions of the gear-wheels and the number of tappet-wheel or cam projections as above described are perhaps the best; but it is not my intention to confine myself to this number of projections on the cam, nor to limit myself to the sizes of the spur-gear and pinion, as the same can be varied without disadvantage. For instance, two projections on the cam, with a medium-sized fly-wheel, may be preferable to a tappet-wheel or cam with three projections and a larger fly-wheel.

It is well understood, by those acquainted with the practical operation of stone-breakers, that the rapid short motions of the jaw L are very essential, and that a balance or fly wheel on the power-shaft which actuates the movable jaw enables the machine to do the work more regularly and perfectly, with a given amount of power, than when constructed without such fly or balance wheel on the said shaft.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination of the upright independently-vibrating crushing or breaking jaw, revolving crushing or breaking cylinder, and a tappet-wheel or a cam acting as a tappet-wheel, the combination being such that the tappet-wheel or cam moves the jaw up to its work directly, and the jaw is free to move away from or toward the tappet-wheel or cam without moving the tappet-wheel or cam along with it, substantially as and for the purpose described.

2. The gears G I, in combination with the driving-shaft H, tappet-wheel J, or cam acting as a tappet-wheel, vibrating jaw L, and cylinder F′, the combination being such that the tappet-wheel or cam moves the jaw up to its work directly, and the jaw is free to move toward or from the tappet-wheel or cam without moving the cam or tappet-wheel along with it, and simultaneously with the movement of the jaw the cylinder is slowly revolved, all substantially as set forth.

3. The fulcrum-pivot K of the jaw L, held eccentrically in adjustable vertically-sliding and reversible blocks which are fitted in oblong slots a of the frame A, substantially in the manner and for the purpose described.

4. The combination of the movable jaw L with a yielding sustaining device, for the purpose of holding the jaw out of contact with the tappet-wheel or cam, which moves it when there is no material between the crushing-surfaces, substantially as described.

Witness my hand, in the matter of my application for a patent for a machine for breaking stone, this 21st day of June, 1877.

PHILETUS W. GATES.

Witnesses:

RYERSON D. GATES,

THOMAS D. JOHNS.